ASPLENIUM X CLERMONTAE SIM FROM CLIFTON GORGE, GREENE COUNTY, OHIO — A SECOND NORTH AMERICAN RECORD[1]

W. H. WAGNER, JR. AND FLORENCE S. WAGNER, The Department of Botany, University of Michigan, Ann Arbor, Michigan 48104

Abstract. The Ohio *Asplenium* X *clermontae*, like the earlier collections from Vermont, seems to differ slightly from the european examples of the same hybrid combination in the structure of the basal pinnae. We examined the meiotic chromosomes in spore mother cells taken from the greenhouse-grown plants. The parents at this locality are both tetraploids, each with $n=72$, $2n=144$. We can conclude we have at least an approximate estimate of pairing behavior in the hybrid.

OHIO J. SCI. 76(3): 99, 1976

Although traditional manuals (e.g., Fernald, 1950) do not mention the presence of *Asplenium* X *clermontae* Sim, the hybrid of wall rue spleenwort, *A. ruta-muraria* L. and maidenhair spleenwort, *A. trichomanes* L., the plant was recorded by Davenport (1906) and Clute (1908). Miss G. A. Woodson found it near Proctor, Vermont, growing within three feet of *Asplenium ruta-muraria* and not very far removed from *A. trichomanes*. Rugg (1912) regarded *A.* X *clermontae* as the "rarest of all Vermont ferns." Clute (1908) predicted that the plant would be found in other regions where both the parent species occur together, but, until the discovery reported here, no one seems to have encountered it. A gap of over a half-century separates the two known collections.

On 11 November 1962 we found two small plants of *A.* X *clermontae* at Clifton Gorge, Greene County, Ohio. At that time Clifton Gorge was an outstanding locality for limestone ferns. We recorded as abundant there such diverse species of spleenworts as *Asplenium platyneuron*, *A. ruta-muraria* var. *ohionis*, *A. trichomanes*, and *Camptosorus rhizophyllus*. There were two small plants that appeared to represent *A.* X *clermontae* and there were probably others. We took them to Ann Arbor for study in the laboratory and greenhouse. Specimens from these plants are illustrated in fig. 1, and were distributed to various herbaria under the field number *Wagner 62375*.

The ferns were planted in a mixture of limestone chips and soil, and they rapidly achieved full size and became fertile. The frond structure left no doubt that they were *A.* X *clermontae*. Their spores further confirmed their hybrid nature, being strongly abortive. One of the plants died after several years, but the other grew until 1970, continually producing new fronds.

Fronds only 3 cm tall bore sori (fig. 1, d). Small fronds were relatively broad, but older ones were narrower, approaching *A. trichomanes* in over-all outline (fig. 1, a, e). The largest fronds produced by our plants were nearly 13 cm in length with as many as 9 pinnae on a side. Occasional fronds of average size showed only 4 or 5 pinnae on a side, these separated by rachis segments up to 1 cm in length. Normally, the basal pair or two pairs of pinnae were divided into pinnules (fig. 1 a, d, e) but this was not always the case. Some showed basal pinnae which were only shallowly lobed or not lobed at all (fig. 1, b, c). Different fronds combined the parental character-states in different ways: Some had numerous pinnae as in *A. trichomanes;* some had few as in *A. ruta-muraria*. Some had divided basal pinnae, as noted, some had simple. Some had ovate pinnae, some

[1]Manuscript received October 23, 1975, and in revised form February 23, 1976 (#75-63).

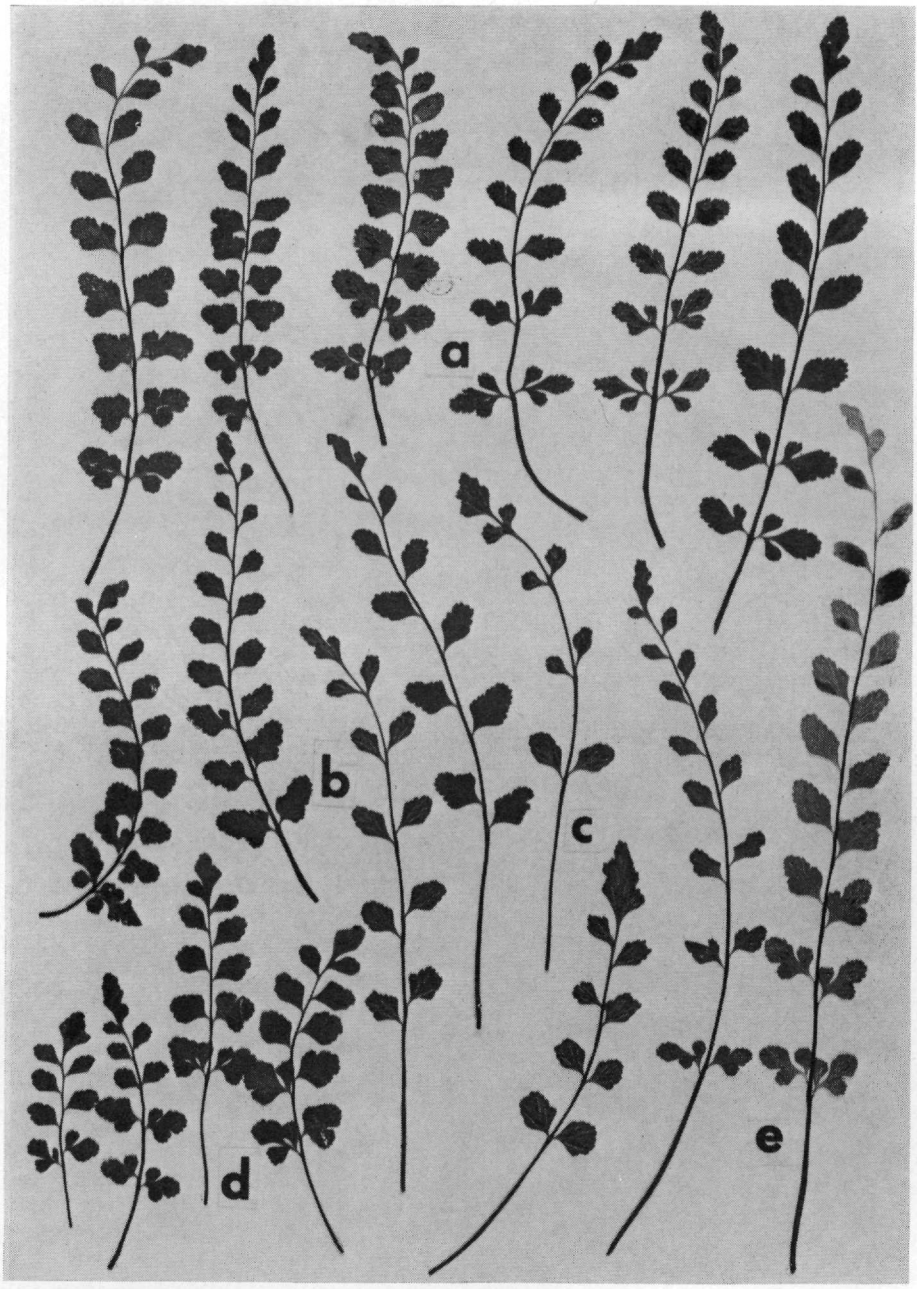

FIGURE 1. Examples of greenhouse-grown fronds of the hybrid of *Asplenium ruta-muraria* and *A. trichomanes*, known as *A.* X *clermontae*, from Clifton Gorge.
a and e—Blade outline as in *A. trichomanes*
b and c—Basal pinnae as in *A. trichomanes*
d—Blade outline as in *A. ruta-muraria*
a, d, e—Basal pinnae as in *A. ruta-muraria*

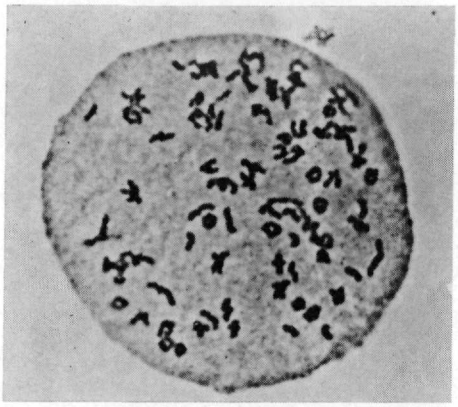

FIGURE 2. A typical example of a sporocyte of *Asplenium* X *clermontae* from Clifton Gorge at meiotic metaphase showing the large number of bivalents.

rhomboidal. Thus there was irregularity in parental expressions from frond to frond, but any individual frond was usually symmetrical as shown in fig. 1.

We examined the meiotic chromosomes in spore mother cells taken from the greenhouse-grown plants. They turned out to be unusually difficult to work with because of very irregular pairing behavior (fig. 2). The six best figures were given the following preliminary interpretations:

Meiotic Figure	Pairs	Singles		# of Chromosomes
A.	35	74	=	144
B.	40	59	=	139
C.	44	55	=	143
D.	46	49	=	141
E.	47	52	=	146
F.	52	46	=	150
Averages	44	56	=	144

Those figures which were interpreted as lower than 144 had obviously some bivalents misinterpreted as univalents; and those interpreted as more than 144 had univalents misinterpreted as bivalents. The parents at this locality are both tetraploids, each with $n=72$, $2n=144$, and the hybrid would accordingly be tetraploid as well. Correcting for misinterpreted units, we estimated the average number of chromosome pairs as 44 (ranging from 35–49). Although it is possible that some "bivalents" were actually multivalents (cf. Vida, 1970), multivalents have not been observed by us in our research. From the above data, we can conclude we have at least an approximate estimate of pairing behavior in the hybrid.

DISCUSSION

The Ohio *Asplenium* X *clermontae*, like the earlier collections from Vermont, seems to differ slightly from the European examples of the same hybrid combination in the structure of the basal pinnae. As Davenport (1906) noted, "the lower pinnae [are] more deeply lobed or even divided" as compared to the various European forms which usually have unlobed or only slightly lobed basal pinnae. Some American individuals are like the European (e.g., fig. 1, b and c).

No reports have been made concerning the chromosome behavior of European *A.* X *clermontae*, although Lovis (personal communication, 1975) informed us that specimens from near Aspang, Austria, were difficult cytologically and that "the number of bivalents was evidently variable." There is no reason to believe that bivalent formation in our Ohio *A.* X *clermontae* indicates chromosome homology between *A. ruta-muraria* and *A. trichomanes*. More likely it involves chromosomes of the same parent. On the basis of studies of polyploidy in *A. ruta-muraria* by Vida (1970) there is evidence that the tetraploid condition results from autopolyploidization of a diploid that has recently been discovered. If only the chromosomes of *A. ruta-muraria* were paired in our *A.* X *clermontae*, then there should be only 36 pairs. From our data, the number of pairs averages 8 more than this, suggesting that there is a certain amount of pairing between the genomes of *A. trichomanes*.

On 3 June 1975 we revisited Clifton Gorge in the hope of seeing more plants of *A.* X *clermontae*. The area where the ferns grew has been made into a scientific preserve under the Department of Natural Resources of the State of Ohio, but the numbers of most of the fern species have decreased as a result of shading by the large trees, older by 13 years than at